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Travel for medical or dental care by race/ethnicity and rurality in the U.S.: Findings from the 2001, 2009 and 2017 National Household Travel Surveys

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ABSTRACT

The travel burden for medical or dental care is a well-documented barrier to healthcare access, particularly in rural areas. There is limited research providing national estimates of the travel trends for medical/dental care, particularly among racial/ethnic groups, and among rural and urban populations. We analyzed data from the 2001, 2009, and 2017 National Household Travel Surveys. Main outcomes were the average travel distance (in miles), average travel time (in minutes), and travel burden, characterized as the percentage of trips lasting ≥ 30 miles or minutes for medical/dental care. We used ordinary least squares and multivariable logistic regressions to examine trends in the travel time/distance and travel burden, controlling for socio-demographic and travel dynamics. Among rural residents, the average travel distance for medical/dental care increased by 17.8% between 2001 and 2017, while no increase was observed among urban residents. Thirty-six percent of trips among rural residents lasted ≥ 30 minutes in 2001 but increased to 47.4% in 2017. Logistic regression estimates show that though Blacks experienced higher odds of a *travel time burden* compared to Whites, the burden lessened over time. In 2017, urban Blacks (OR = 0.41, 95% C.I. = 0.26,0.66), and rural Blacks (OR = 0.16, 95% C.I. = 0.05,0.55) were less likely to spend ≥ 30 minutes traveling for medical/dental care compared to Whites, using the year 2001 as the baseline. The travel distance and time for medical/dental care have increased in rural areas. However, the travel burden among rural and urban Black residents has decreased. Continuing to alleviate excess burdens of transportation may be beneficial.

1. Introduction

As part of the built environment, transportation is a social determinant of health for individuals and a driver of health and equity for societies (Health Affairs Health Policy Brief, 2021). Transportation promotes health equity for societies by increasing access to work opportunities, healthier food, and healthcare (Combs et al., 2016; Probst et al., 2007). In the United States, many rural residents must travel long distances to receive care due to shortages in primary and specialty care, and the lack of public transportation options in rural areas (Wallace et al., 2005; Akinlotan et al., 2021).

The high rural travel burden is not without consequences; it has been associated with delayed or forgone care and missed outpatient appointments, which have led to increased hospital-based care, greater disease burden, reduced treatment compliance, and poorer health outcomes (Wallace et al., 2005; Ambroggi et al., 2015; Thomas et al., 2018). Previous research noted that longer travel distance is particularly higher among racial/ethnic minorities, those with low English proficiency and

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low incomes, and among special populations such as the rural elderly, those with certain chronic conditions, and veterans (Combs et al., 2016; Wallace et al., 2005; Buzza et al., 2011). Regardless of social or clinical factors, longer travel distance has been associated with reduced or poorer glycemic control and worse cancer-specific outcomes among those receiving treatment for diabetes and cancer (Littenberg et al., 2006; Strauss et al., 2006; Loree et al., 2017).

Measuring the travel distance and time for medical/dental care has been used in several studies as a measure of transportation barriers (Kruzich et al., 2003; Nemet and Bailey, 2000; Okoro et al., 2005; Probst et al., 2007; Akinlotan et al., 2021). Previous studies have provided national estimates of the travel time and distance in 2001 and 2017 (Probst et al., 2007; Akinlotan et al., 2021). However to our knowledge, no study has examined how the travel burden has changed over time, particularly for racial/ethnic groups, and among rural and urban populations. The purpose of this study was to provide national estimates of the racial/ethnic and rural–urban trends in travel distance and time for medical/dental care. The secondary aim was to examine how the odds of a high travel burden changed over time by race/ethnicity and rurality, controlling for socio-demographic and travel dynamics.

2. Methods

2.1. Data source

The National Household Travel Survey (NHTS) is a nationally representative survey and a source of information on the travel behaviors of the American public and is useful for analyzing changes in travel patterns over time. Data were de-identified and publicly available, and thus, exempt from institutional review board review. We analyzed data from the 2001, 2009, and 2017 surveys, conducted by the Federal Highway Administration. The NHTS is a stratified random sample of civilian, noninstitutionalized U.S. households (Federal Highway Administration, 2017a). The NHTS was first conducted in 1969, and subsequent surveys were conducted in 1977, 1983, 1990, 1995, 2001, 2009, and 2017. The 2001 and 2009 survey data were collected primarily through landline telephone-based interviews, while the 2017 survey was conducted through address-based sampling in which residential addresses were randomly selected. The 2017 survey was conducted in two phases: 1) mailed-based surveys which collected core information about the household characteristics, transportation, and travel experiences; 2) a web-based 24-hour travel diary in which respondents recorded individual travel activities on a randomly assigned weekday (Federal Highway Administration, 2017b).

All trip purposes were captured in the NHTS, including trips for medical/dental care, school, work, religious activity, recreation, and personal/family trips; as were all modes of travel, including private, public, pedestrian and cycling. Trips for medical and dental care were not distinguished. We merged data from the NHTS household, personal, and trip files to obtain demographic and household information on the individual who made the trip. We conducted the analyses at the trip level.

In the 2001 NHTS, 160,758 persons from 69,817 households were surveyed, 324,184 persons from 150,184 households in 2009, and 264,234 individuals from 129,112 households in 2017. There were no age restrictions in the 2001 survey, but only individuals aged 5 and up were surveyed in 2009 and 2017. Given that the focus of the study was travel distance and time for medical/dental care regardless of age or driving status on the trip, all persons over age 5 were included in the study. The weighted response rates were 41% in 2001, 19.8% in 2009 and 33.4% in 2017. The low response rate in 2009 has been attributed to the waning use of household landlines and the use of caller ID to screen out solicitation calls (Pucher et al., 2011).

3. Measures

3.1. Dependent variable

There were two main outcomes for this study: the one-way travel distance in miles for medical/dental care and the associated travel time in minutes. To calculate travel distance and time, respondents were asked to provide the names and addresses of all destinations listed in the travel log, as well as their departure and arrival times. In the 2017 NHTS, a trip was defined as the shortest network path distance generated by Google maps for a one-way trip. Self-reported distances were used in the 2001 and 2009 surveys. To measure the burden of travel for medical/dental care, we identified trips that were $\geq$ 30 miles or minutes as indicators of a high travel burden, consistent with previous research (Probst et al., 2007). For ease of reporting, we have expressed these as the *travel distance burden*, and the *travel time burden*. Trips for medical/dental care were placed in the context of work travel to better understand the travel burden for medical/dental care purposes. To prevent trips with unreasonably long values from biasing our mean estimates, we excluded trips that were beyond 300 miles or 300 minutes.

3.2. Independent variables

There were two main explanatory variables in this study: the rural/urban classification of the respondent's home location and race/ethnicity. Rural/urban classification was developed by Claritas Inc (Federal Highway Administration, 2017b) and classified into urban, suburban, second city, town and rural segments based on a population density grid and proximity to urban segments. The ranked grid was divided into centiles, with zero representing areas with little or no population, and 100 representing the densest neighborhoods in the United States.

The urban segment represents regions with population density scores between 75 and 99 and captures places like downtown areas of major cities and the population centers of communities. Suburban segments refer to areas with density scores between 40 and 90. These areas are not the major population center of their surrounding communities. They are usually a continuum of the urban segments or second cities (defined below), but with lower population densities compared to major population centers. The second cities also have population densities scores between 40 and 90 but differ from suburban segments in that they are the major population centers of their surrounding communities and are located within larger towns and smaller cities. Town and rural segments are areas with population densities between 0 and 40, and includes towns, villages, rural communities, and farmlands outside of suburban areas. For purposes of this study, households in urban, suburban, and second city segments were classified as urban, while those in town and rural segments were classified as rural. Race/ethnicity was classified as White, Black/African American, Hispanic, and Other due to the limited sample size in some groups.

3.3. Other covariates

In analyzing rural–urban differences in the travel distance/time and predictors of the high travel burden in both geographical areas, we controlled for certain variables based on prior work conducted in this area (Probst et al., 2007), though a bivariate analysis was also conducted. These were age (5–17, 18–34, 35–49, 50–64, and 65 and older), gender (male/female), and indicators of socio-economic status including household income (less than $25,000, $25,000-$49,999, $50,000-$74,999, $75,000-$99,999, $100,000 or more, and missing), and education (high school or lower, some college/college graduate, and graduate). We controlled for health status, measured by whether the respondent had a medical condition that resulted in giving up driving (yes/no). We also controlled for trip characteristics such as mode of transportation (personal vehicle, public transportation, taxi/Uber/Lyft,

and other), trip start time (midnight to 6:59 a.m., 7:00 a.m. to 4:59p.m., and 5:00p.m. to 11:59p.m.). The trip start time was only included in the models predicting the travel time and the *travel time burden*. Additionally, we included the census region where the respondent resided (Northeast, Midwest, South, and West census regions).

3.4. Statistical analysis

We used weights provided in the trip file in all the analyses. We used descriptive statistics to generate the average travel miles and minutes for medical/dental care by rural–urban residence, and race/ethnicity for each study year. We also calculated the percentage of those who traveled for ≥ 30 miles or minutes for medical/dental care, and for work, by rural–urban status. In conducting trend analysis, we used linear regression with year as the independent variable and average travel distance/time as the dependent variable to determine whether there were any statistically significant changes over time. No covariates were considered in the trend analysis. This is consistent with guidelines outlined in the literature for conducting trend analysis with few time points (Ingram et al., 2018). For travel distance and time, we used multiple ordinary least squares regressions to further test whether the rural–urban differences had changed over time. We included the interaction term "Rural/urban status × Year" to test these changes. We used separate multivariable logistic regressions to estimate the adjusted odds ratios with 95% confidence intervals of a higher travel burden among racial/ethnic populations living in rural and urban areas. To describe changes in the odds of a high travel burden over time by race/ethnicity, we included an interaction term for "Race/Ethnicity × Year" in the regression models. We also generated interaction plots to demonstrate changes in the predicted probability of these outcomes. Observations with missing data on covariates were excluded from the regression via listwise deletion (n = 3,185). In all statistical tests, the alpha level of significance was set at 0.05. All analyses were conducted using Stata 16 (College Station, Texas, USA).

4. Results

A weighted total of 17.5 billion trips were made for medical/dental care in 2001, 2009, and 2017 (unweighted n = 49,470). Trips for medical/dental care accounted for 1.4% of all trips in 2001, 1.6% in 2009, and 1.5% in 2017. About four-fifths of medical/dental trips were made by urban residents (79%), while 21% were from rural residents. On average, US residents covered 0.16 more miles and spent 3.9 more minutes in travel for medical/dental care in 2017 than in 2001.

Descriptive characteristics of the travelers are presented in Appendix 1 Table 1. Among urban travelers, 63.9% identified as White, 14.1% as Black, 15.6% as Hispanic and 6% as 'Other' race. For rural travelers, 85.2% identified as White, 6.9% as Black, 4.8% as Hispanic, and 3.1% as 'Other'. Compared to urban travelers, those from rural areas were more likely to be male, with high school education or lower, and with incomes between $25,000 and $99,000. Rural travelers were less likely to have a travel limiting condition and more likely to use private vehicles as their mode of transportation. They were more also likely to travel for medical/dental care on weekdays and start their trips before work hours.

4.1. Urban and rural travel trends for medical/dental care

The average travel *distance* for medical/dental care increased in rural areas, from 15.16 miles in 2001, 16.94 miles in 2009, to 17.93 miles in 2017 (p = 0.014) (Table 1 & Fig. 1). No increase was observed in urban areas.

In contrast, an increase in average travel *time* was observed generally, and across rural and urban areas. Between 2001 and 2017, U.S. residents spent 3.91 more minutes traveling for medical/dental care (p < 0.001), urban residents spent 3.33 more minutes (p = 0.002), and rural residents spent 7.17 more minutes (p < 0.001).

Table 1
Average miles and minutes spent for medical/dental care travel in the U.S. by rurality and race/ethnicity, National Household Travel Survey, 2001, 2009, 2017.

	Miles per trip (Standard Error)				Minutes per trip (Standard Error)			
Year	2001 (n = 9,241)	2009 (n = 23,499)	2017 (n = 16,784)	P value	2001 (n = 9,241)	2009 (n = 23,499)	2017 (n = 16,784)	P value
Travel for medical/dental care by rurality								
Average	9.88 (0.28)	9.55 (0.36)	10.04 (0.29)	0.70	23.17 (0.46)	23.97 (0.48)	27.08 (0.50)	< 0.001
Urban residents	8.40 (0.31)	7.48 (0.27)	8.20 (0.25)	0.64	22.11 (0.49)	22.77 (0.52)	25.44 (0.50)	< 0.001
Rural residents	15.16 (0.56)	16.94 (1.22)	17.93 (1.01)	0.01	26.94 (1.16)	28.23 (1.16)	34.11 (1.51)	< 0.001
Rural-Urban difference	+6.76	+9.46	+9.73		+4.83	+5.46	+8.67	
Travel for medical/dental care by rurality & race/ethnicity								
Urban Whites	8.46 (0.35)	8.47 (0.38)	8.00 (0.25)	0.30	19.65 (0.43)	21.45 (0.71)	23.14 (0.50)	< 0.001
Rural Whites	15.02 (0.61)	16.77 (1.43)	16.67 (0.95)	0.08	26.47 (1.30)	28.01 (1.36)	33.26 (1.58)	0.001
Urban Blacks	7.88 (0.76)	6.44 (0.50)	8.29 (0.96)	0.65	29.69 (1.67)	25.73 (1.27)	32.69 (2.06)	0.19
Rural Blacks	16.10 (2.49)	19.67 (2.47)	24.14 (4.58)	0.12	31.94 (4.76)	29.22 (1.94)	40.34 (8.97)	0.45
Urban Hispanics	7.74 (1.13)	5.12 (0.53)	8.99 (0.71)	0.24	26.07 (2.01)	26.68 (0.94)	27.67 (1.32)	0.50
Rural Hispanics	16.99 (2.10)	15.03 (1.63)	28.32 (7.51)	0.15	25.36 (2.83)	30.08 (1.95)	44.40 (6.35)	0.01
Urban 'Other' race	11.4 (1.57)	6.0 (0.79)	7.77 (0.72)	0.06	26.64 (2.54)	19.38 (1.59)	23.12 (1.25)	0.32
Rural 'Other' race	17.02 (2.87)	19.46 (2.24)	10.72 (1.33)	0.12	33.16 (5.10)	30.08 (2.78)	23.9 (3.16)	0.14
Travel for work								
Average	12.43 (0.41)	11.89 (0.42)	12.78 (0.51)	0.67	23.03 (0.59)	22.83 (0.61)	26.87 (0.87)	< 0.001
Urban residents	11.60 (0.43)	10.69 (0.42)	11.82 (0.54)	0.23	22.97 (0.67)	22.22 (0.61)	26.67 (0.98)	0.002
Rural residents	15.45 (1.02)	16.01 (1.15)	18.12 (1.38)	0.14	23.29 (1.24)	25.07 (1.71)	28.05 (1.68)	0.03
Rural-Urban difference	+3.85	+5.32	+6.3		+0.32	+2.85	+1.38	

*P values obtained from F tests, average travel miles and minutes regressed on year

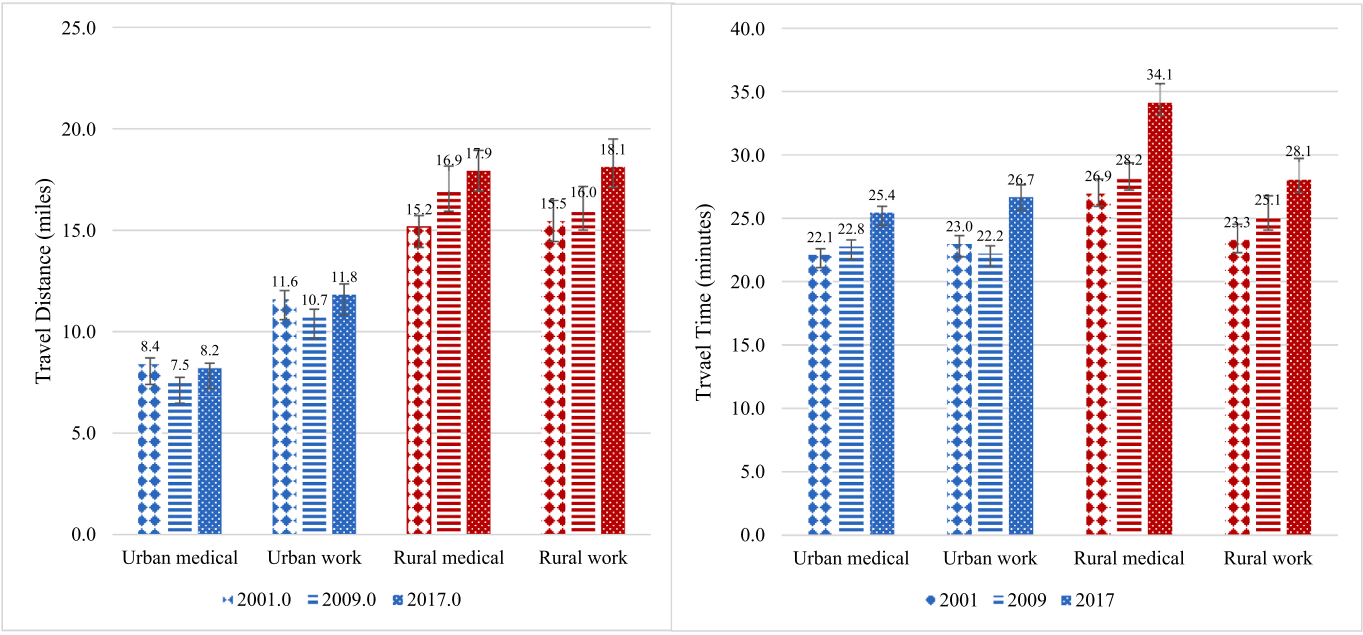

Fig. 1. Average miles and minutes spent for medical/dental care and work travel in the U.S. by rurality, National Household Travel Survey, 2001, 2009, 2017. n = 9,241 (year 2001), 23,499 (year 2009), 16,784 (year 2017).

4.2. Rural/urban differences in travel trends for medical/dental care

Unadjusted estimates show that the rural–urban difference in the *travel distance and time* for medical/dental trips increased over the study period (Table 1 & Fig. 1). However, the adjusted regression model showed that only the 2017 rural–urban differences were statistically significant, compared to 2001 (Appendix Table 3). Rural residents in 2017 traveled 2.5 miles further (95% C.I. 0.01, 5.00) and spent 5.3 minutes more (95% C.I. 1.08,9.22) in transit for medical/dental care compared to urban residents, using the year 2001 as the baseline.

4.3. Rural/urban differences in travel trends for medical/dental care by race/ethnicity

In exploring travel burden in the context of race and ethnicity, the travel *time* and *distance* for rural Black and Hispanic residents was generally higher compared to rural Whites (Table 1, Appendix Table 3). Except for travel *time* increases among urban Whites ($p < 0.001$), rural Whites ($p = 0.001$), and rural Hispanics ($p = 0.008$), other observed increases were not statistically significant at $p < 0.05$.

4.4. Travel for medical/dental care in the context of work

In 2001, 2009, and 2017, urban residents traveled farther for work than they did for medical/dental care (urban work travel: 2001 = 11.6 miles, 2009 = 10.7 miles, 2017 = 11.8 miles) (Fig. 1), while rural residents covered similar distances for work and medical/dental care (rural work travel: 2001 = 15.5 miles, 2009 = 16.0 miles, 2017 = 18.1 miles).

4.5. Rural/urban differences in the burden of medical/dental care

Table 2 and Fig. 2 describe the percentage of trips for medical/dental care that were ≥ 30 miles or 30 minutes. In rural areas, over one-third of medical/dental trips were 30 minutes or more in 2001 (35.6%), while almost half of such trips lasted 30 minutes or more in 2017 (47.4%). The *travel time burden* increased for both urban and rural residents (p value: urban=<0.001, rural=<0.001).

Table 2
Percentage of trips for medical/dental care and work lasting ≥ 30 miles or minutes (travel burden) in the U.S. by rurality, National Household Travel Survey, 2001, 2009, 2017.

	Percentage of trips ≥ 30 miles (Standard Error)				Percentage of trips ≥ 30 minutes (Standard Error)			
Year	2001 (n = 9,241)	2009 (n = 23,499)	2017 (n = 16,784)	*P value	2001 (n = 9,241)	2009 (n = 23,499)	2017 (n = 16,784)	*P value
Trips for medical/dental care								
Average	7.13 (0.48)	6.11 (0.42)	6.31 (0.48)	0.23	28.99 (0.87)	29.13 (0.91)	35.28 (0.94)	< 0.001
Urban residents	5.03 (0.49)	3.65 (0.34)	3.86 (0.38)	0.06	27.14 (1.00)	26.83 (1.02)	32.46 (1.03)	< 0.001
Rural residents	14.61 (1.28)	14.9 (0.42)	16.84 (1.84)	0.32	35.55 (1.78)	37.31 (1.88)	47.37 (2.26)	< 0.001
Rural-Urban difference	+9.58	+11.22	+12.98		+8.41	+10.48	+14.91	
Trips for work								
Average	9.59 (0.96)	9.49 (0.01)	8.84 (1.01)	0.61	30.57 (1.59)	30.68 (1.71)	36.51 (1.85)	0.02
Urban residents	8.29 (1.07)	7.19 (0.97)	7.34 (1.07)	0.52	30.41 (1.83)	29.12 (1.92)	36.29 (2.06)	0.04
Rural residents	14.29 (0.21)	17.59 (3.24)	17.24 (3.06)	0.30	31.12 (3.15)	36.41 (3.17)	37.78 (4.48)	0.19
Rural-Urban difference	+6	+10.4	+9.9		+0.71	+7.29	+1.49	

*P values obtained from F tests.

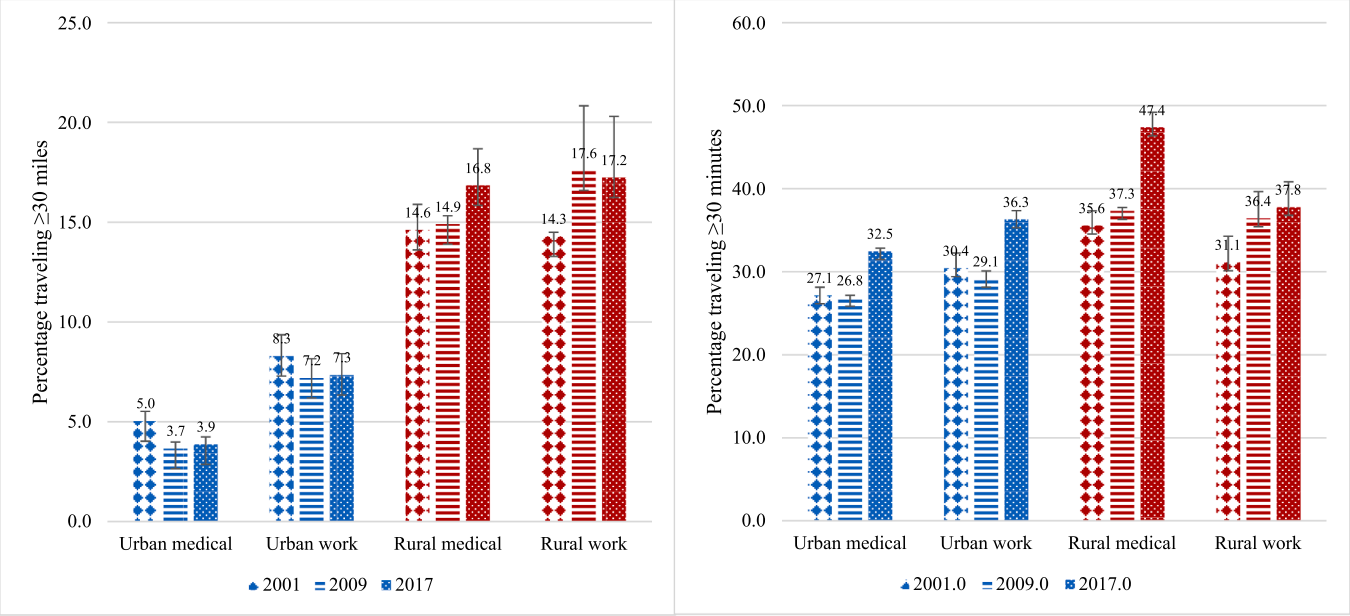

Fig. 2. Percentage of medical/dental care and work travel lasting ≥ 30 miles or minutes in the U.S. by rurality (travel burden), National Household Travel Survey, 2001, 2009, 2017. n = 9,241 (year 2001), 23,499 (year 2009), 16,784 (year 2017).

4.6. Travel burden trends among racial/ethnic sub-populations in rural and urban areas

After controlling for covariates, compared to 2001, urban Hispanics (OR = 0.43, 95% C.I. = 0.20, 0.89), and the rural 'Other race' category (OR = 0.15, 95% C.I. = 0.04, 0.63) experienced a lower *travel distance burden* in 2009, and 2017, respectively (Table 3).

Even though the main effects demonstrate that Blacks had a higher *travel time burden* compared to Whites, interaction effects show that the burden lessened over time. In 2017, urban Blacks (OR = 0.41, 95% C.I. = 0.26,0.66), and rural Blacks (OR = 0.16, 95% C.I. = 0.05,0.55) were less likely to spend ≥ 30 minutes traveling for medical/dental care compared to in 2001. Similarly, urban residents in the 'Other' racial category were less likely to spend ≥ 30 minutes traveling for medical/dental care in 2017 compared to 2001 (OR = 0.36, 95% C.I. = 0.20,0.67). Interaction plots are presented in Appendix Figs. 1 to 4.

5. Discussion

In this study, our goal was to examine rural–urban, and racial/ethnic trends in the travel distance and time for medical/dental care trips from 2001 to 2017, and to examine how the odds of a high travel burden changed over time by race/ethnicity, controlling for socio-demographic and travel dynamics. Trend analyses show that rural residents traveled farther for medical/dental care in 2017 compared to 2001, while the distance covered by urban residents remained relatively unchanged. However, the travel time increased for both rural and urban residents over the study period. After adjusting for sociodemographic and trip characteristics, rural residents traveled about three miles further and spent five more minutes in transit for medical/dental care in 2017 compared to urban residents, using 2001 as the baseline. Regarding travel burden, between 2001 and 2017, the proportion of those traveling ≥ 30 minutes increased by 33% for rural residents, and 20% for urban residents.

Across race/ethnicity, interaction effects show that the *travel time burden* remained stable for Hispanics but declined over time among urban and rural Blacks and the urban 'Other' racial category. The *travel distance burden* decreased among rural residents in the 'Other' racial category as well.

These findings are consistent with those of previous studies that have reported increased rural–urban differences in medical/dental travel (Akinlotan et al., 2021; Henning-Smith et al., 2017). These disparities may partly be explained by factors that are intrinsic to the geography of rural areas, such as the dispersion and isolation of small communities, low population density, terrains that make transportation difficult, and limited route opportunities (Henning-Smith et al., 2017). Others are more administrative and policy-related and include poor infrastructure, low funding for transit services due to state budget cuts, group transportation, rural hospital closures, and rural hospital consolidation resulting in narrowing of available services (Henning-Smith et al., 2017). Of note, the accelerating rate of rural hospital closures have been associated with increased transport times (Miller et al., 2020). There were 126 complete and partial rural hospital closures between 2005 and 2017 (UNC Sheps Center, 2022).

In addition to the rising hospital closure rates, there have been other notable trends in the U.S. healthcare landscape. These include financial challenges that threaten the viability of many private practices, and the subsequent vertical integration of providers into large healthcare systems. Notably, however, some centralization of care into high volume centers of excellence may be beneficial, even if some patients must travel farther to access such care (Feazel et al., 2015). It is also important to note that the increase in travel burdened trips among rural residents may not represent decreased access to care. Demographic changes such as the ageing rural population, low gas prices, and increased access to care due to the passage of the Affordable Care Act may be associated with more increased use of healthcare services despite the travel burden. Our finding that the travel burden decreased for rural and urban Blacks may also reflect the gains accruing from the Affordable Care Act which increased access to care for racial/ethnic minorities, particularly in Medicaid-expanded states (Chaudry et al., 2019).

In our study, the *travel time burden* increased for both urban and rural residents. Increased commute times in the United States reached a new high in 2018 due to increased travel for work, the growth of suburban housing, and slower transit infrastructure development in metropolitan areas (US Census Bureau, 2022). For rural residents, placing the travel burden for medical/dental care in the context of work travel shows that long commutes are part of rural living. Nonetheless, more time was spent traveling for healthcare than for work within this group. The

Table 3
Factors associated with travel for medical/dental care lasting ≥ 30 miles or minutes in the U.S. by rurality, National Household Travel Survey, 2001, 2009, and 2017.

	Travel of 30 miles of more		Travel of 30 minutes of more	
Rurality	Urban residents (Model 1)	Rural residents (Model 2)	Urban residents (Model 3)	Rural residents (Model 4)
	n = 34,182 Odds Ratios, 95% C.I.	n = 12,014	n = 35,917	n = 12,732
Race/ethnicity				
White	Reference	Reference	Reference	Reference
Black	0.86 [0.39,1.93]	1.80 [0.62,5.25]	2.69 [1.90,3.79]***	3.08 [1.31,7.22]**
Hispanic	1.40 [0.77,2.53]	0.99 [0.28,3.56]	1.58 [1.14,2.17]**	1.96 [0.74,5.14]
Other	2.23 [0.91,5.46]	1.44 [0.52,3.97]	1.90 [1.19,3.02]**	0.77 [0.31,1.89]
Year				
Year 2001	Reference	Reference	Reference	Reference
Year 2009	0.76 [0.54,1.08]	1.03 [0.73,1.44]	1.07 [0.89,1.29]	0.96 [0.75,1.23]
Year 2017	0.67 [0.47,0.96]*	1.07 [0.76,1.50]	1.46 [1.22,1.75]***	1.62 [1.23,2.12]***
Interaction effects: (Race/ethnicity × Year)				
Omits: White, Year 2001				
Omits: White, Year 2009				
Omits: White, Year 2017				
Omits: Black, Year 2001				
Omits: Hispanic, Year 2001				
Omits: Other race, Year 2001				
Black × Year 2009	0.77 [0.30,1.95]	0.44 [0.12,1.57]	0.50 [0.30,0.83]**	0.66 [0.22,1.99]
Black × Year 2017	1.60 [0.59,4.36]	1.91 [0.45,8.23]	0.41 [0.26,0.66]***	0.16 [0.05,0.55]**
Hispanic × Year 2009	0.43 [0.20,0.89]*	1.35 [0.33,5.54]	1.21 [0.77,1.88]	0.94 [0.31,2.79]
Hispanic × Year 2017	0.66 [0.32,1.36]	2.65 [0.49,14.23]	0.81 [0.53,1.24]	1.85 [0.53,6.44]
Other race × Year 2009	0.32 [0.09,1.11]	0.83 [0.20,3.41]	0.45 [0.22,0.92]*	1.55 [0.51,4.67]
Other race × Year 2017	0.41 [0.12,1.48]	0.15 [0.04,0.63]**	0.36 [0.20,0.67]**	0.40 [0.12,1.34]
Age				
5 to 17	0.29 [0.13,0.63]**	0.59 [0.28,1.26]	0.62 [0.44,0.87]**	0.82 [0.47,1.40]
18 to 34	Reference	Reference	Reference	Reference
35 to 49	0.79 [0.53,1.18]	0.77 [0.48,1.25]	0.77 [0.62,0.96]*	0.87 [0.61,1.26]
50 to 64	1.04 [0.72,1.51]	1.10 [0.70,1.75]	0.98 [0.79,1.21]	0.88 [0.62,1.26]
Over 65	0.71 [0.48,1.05]	0.86 [0.55,1.35]	0.97 [0.79,1.20]	1.12 [0.79,1.59]
Gender				
Male	1.30 [1.02,1.64]*	1.06 [0.82,1.37]	1.20 [1.06,1.37]**	1.04 [0.85,1.27]
Female	Reference	Reference	Reference	Reference
Education				
High School or Lower	1.92 [0.97,3.83]	2.25 [0.66,7.58]	0.68 [0.49,0.93]*	2.65 [1.06,6.62]*
Some College	2.18 [1.14,4.15]*	1.96 [0.59,6.59]	0.71 [0.52,0.96]*	2.22 [0.89,5.55]
Graduate	Reference	Reference	Reference	Reference
Household income				
<24999	1.12 [0.68,1.85]	2.20 [1.35,3.57]**	1.39 [1.12,1.74]**	1.95 [1.35,2.80]***
25000–49999	0.93 [0.62,1.39]	2.22 [1.37,3.60]**	1.09 [0.89,1.34]	1.53 [1.09,2.14]*
50000–74999	0.99 [0.66,1.49]	2.52 [1.56,4.05]***	0.88 [0.71,1.09]	1.20 [0.85,1.70]
75000–99999	0.87 [0.57,1.34]	1.71 [0.93,3.12]	0.89 [0.71,1.11]	1.27 [0.83,1.93]
Over_100000	Reference	Reference	Reference	Reference
Missing	1.01 [0.46,2.18]	2.04 [0.87,4.77]	1.29 [0.97,1.72]	1.17 [0.71,1.90]
Travel limiting medical condition				
Yes	0.76 [0.43,1.35]	0.61 [0.33,1.13]	1.18 [0.87,1.62]	0.59 [0.34,1.03]
No	Reference	Reference	Reference	Reference
Not applicable	0.98 [0.68,1.41]	0.78 [0.56,1.09]	1.07 [0.89,1.27]	0.71 [0.55,0.91]**
Mode of transportation				
Private	Reference	Reference	Reference	Reference
Public	0.94 [0.52,1.71]	0.63 [0.16,2.58]	6.49 [4.91,8.58]***	1.73 [0.55,5.44]
Taxi Uber Lyft	0.04 [0.01,0.29]**	0.21 [0.05,0.90]*	1.73 [0.93,3.21]	0.19 [0.05,0.72]*
Walk	0.01 [0.00,0.07]***	1	0.57 [0.37,0.87]**	0.18 [0.03,1.13]
Other	0.51 [0.22,1.20]	4.24 [0.63,28.39]	1.67 [0.87,3.18]	2.20 [0.67,7.22]
Travel day				
Monday to Friday	0.83 [0.54,1.27]	1.56 [0.88,2.76]	1.12 [0.87,1.46]	1.43 [0.93,2.20]
Weekend	Reference	Reference	Reference	Reference
Trip start time				
Midnight to 6.59 am			1.88 [1.16,3.03]*	12.38 [5.74,26.72]***
Work hours (7:00 am to 4.50 pm)			1.38 [1.02,1.87]*	1.81[1.07,3.07]*
Evening (5.00 pm to 11.59 pm)			Reference	Reference
Census Region				
Northeast	Reference	Reference	Reference	Reference
Midwest	1.29 [0.85,1.96]	1.03 [0.65,1.64]	0.82 [0.65,1.03]	0.77 [0.56,1.05]
South	2.18 [1.55,3.06]***	0.98 [0.64,1.49]	1.15 [0.97,1.38]	0.84 [0.63,1.10]
West	1.76 [1.21,2.54]**	1.14 [0.68,1.89]	0.98 [0.82,1.18]	1.04 [0.73,1.48]

*$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

economic toll of rural hospital closures might involve loss of employment and individuals traveling farther for work. The converse was true for urban residents, who covered more miles and minutes traveling for work than for medical/dental care.

There are implications to the increased travel burden faced by rural residents. The growing rural transportation burden may aggravate the access barriers faced by rural residents; as travel burden increases, access to care drops rapidly in most areas, except those few rural areas that have a myriad of providers (Henning-Smith et al., 2017). The higher travel burden may also imply that rural residents may be traveling for care outside of their communities, which may alter the patient provider relationship (MacKinney et al., 2014). Obviously, increased travel time is associated with higher nonemergency medical travel costs and implies that rural residents may be taking more time off work to seek care. The impact of the increased travel time burden may be most felt by certain segments of the population that rely on transportation to maintain their health: the elderly, the disabled, those with special health care needs, low-income individuals, and families (Rural Health Information Hub, 2022).

There are limitations to this study. First, this is a pooled cross-sectional study and different households may have been surveyed over time. As such, our findings may not reflect longitudinal travel patterns within households. Second, there was no distinction made between emergent, nonemergent, primary, and specialty medical or dental care. It is expected that even within an urban setting, the travel burden would vary based on the type of care sought. The survey's merging of these trip types did not allow us to explore important nuances in terms of the types of care sought and the travel burdens associated with them. Third, we could not delineate the relative contributions of medical versus dental trip types to the data, and how this might vary within populations. For instance, one might expect higher numbers of dental trips among higher income patients. Fourth, there was no information on health insurance, which may have provided greater context on racial-ethnic disparities observed over time. Fifth, Claritas' definition of rurality varies from other established definitions such as the Rural Urban Continuum Code, Rural urban Commuting Area, and the Frontier and the Remote Area Codes. Future research should explore the extent to which our findings are robust to the different ways in which rurality is captured in the U.S. Finally, as noted earlier, the 2001 and 2009 surveys were landline telephone-based samples and trip distance was self-reported, while the 2017 survey was address-based, and Google Maps was used to calculate trip distance. Hence, some of the changes observed between 2009 and 2017 may be due to change in sampling methodology rather than a change in travel patterns. In addition to the change in sampling methodology, the survey response rate in 2009 was extremely low, at 19.8%. Thus, the 2009 transportation estimates may be biased due to non-response; and it is unclear the extent to which non-response was related to transportation patterns.

Questions have been raised on whether to make medical services more available in rural areas or to provide more robust options to transport rural residents to the services they need (Buzza et al., 2011). It is important, however, to provide primary medical services or a basic safety net, while strengthening transportation for specialty services. Programs such as aging services networks have been shown to be a proven way to improve healthcare utilization and bring services closer to ageing rural residents (Henning-Smith et al., 2017).

6. Conclusion

The travel distance and time for medical/dental care has increased in rural areas relative to urban areas. It is reassuring to note that the travel burden (in terms of time or distance) decreased for Blacks and those in the 'Other' racial group in 2017, though it remained stable for Hispanics. Alleviating excess burdens of transportation may increase health services utilization, reduce foregone care, decrease misuse of emergency medical services, reduce the potential of the elderly leaving the community or entering into long-term care (Rural Health Information Hub, 2022), and improve mental health.

CRediT authorship contribution statement

Marvellous Akinlotan: Conceptualization, Methodology, Formal analysis, Writing – original draft, Visualization, Project administration. **Nima Khodakarami:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Visualization. **Kristin Primm:** Conceptualization, Methodology, Writing – review & editing. **Jane Bolin:** Conceptualization, Resources, Writing – review & editing, Funding acquisition. **Alva O. Ferdinand:** Conceptualization, Methodology, Resources, Writing – review & editing, Visualization, Supervision, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2023.102297.

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